

CARBON CYCLE

Carbon is the basic building block of all organic materials, and therefore, of living organisms. However, the vast majority of carbon resides as inorganic minerals in crustal rocks. Other reservoirs of carbon include the oceans and atmosphere. Several physical processes affect carbon as it moves from one reservoir to another. The inter-relationships of carbon and the biosphere, atmosphere, oceans and crustal earth -- and the processes affecting it -- are described by the carbon cycle.

The carbon cycle is actually comprised of several inter-connected cycles. The overall effect is that carbon is constantly recycled in the dynamic processes taking place in the atmosphere, at the surface and in the crust of the earth. For example, the combustion of wood transfers carbon dioxide to the atmosphere. The carbon dioxide is taken in by plants and converted to nutrients for growth and sustenance. Animals eat the plants for food and exhale carbon dioxide into the atmosphere when they breathe.

Atmospheric carbon dioxide dissolves in the ocean where it eventually precipitates as carbonate in sediments. The ocean sediments are subducted by the actions of plate tectonics, melted and then returned to the surface during volcanic activity. Carbon dioxide gas is released into the atmosphere during volcanic eruptions. Some of the carbon atoms in your body today may long ago have resided in a dinosaur's body, or perhaps were once buried deep in the earth's crust as carbonate rock minerals.

The main carbon cycling processes involving living organisms are photosynthesis and respiration. These processes are actually reciprocal to one another with regard to the cycling of carbon: photosynthesis removes carbon dioxide from the atmosphere and respiration returns it. A significant disruption of one process can therefore affect the amount of carbon dioxide in the atmosphere.

Plants absorb carbon dioxide from the atmosphere through their leaves and absorb water from the soil through their roots.



During a process called photosynthesis, raw materials are used to manufacture sugar. Photosynthesis occurs in the presence of chlorophyll, a green plant pigment that helps the plant utilize the energy from sunlight to drive the process. Although the overall process involves a series of reactions, the net reaction can be represented by the following:

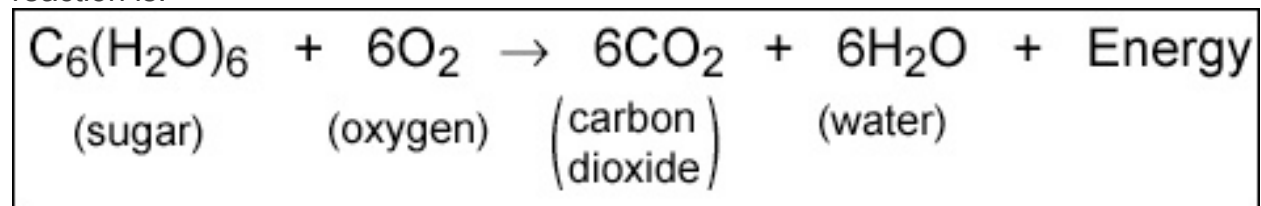


The sugar provides a source of energy for other plant processes and is also used for synthesizing materials necessary for plant growth and maintenance. The net effect with

regard to carbon is that it is removed from the atmosphere and incorporated into the plant as organic materials.



The reciprocal process of photosynthesis is called respiration. The net result of this process is that sugar is broken down by oxygen into carbon dioxide and water. The net reaction is:



This process occurs not only in plants, but also in humans and animals. Unlike photosynthesis, respiration can occur during both the day and night. During respiration, carbon is removed from organic materials and expelled into the atmosphere as carbon dioxide.

Another process by which organic material is recycled is the decomposition of dead plants and animals. During this process, bacteria break down the complex organic compounds.

Carbon is released into the soil or water as inorganic material or into the atmosphere as gases. Decomposed plant material is sometimes buried and compressed between layers of sediments. After millions of years fossil fuels such as coal and oil are formed. When fossil fuels are burned, the carbon is returned to the atmosphere as carbon dioxide.

The carbon cycle is very important to the existence of life on earth. The daily maintenance of living organisms depends on the ready availability of different forms of carbon. Fossil fuels provide an important source of energy for humans, as well as the raw materials used for manufacturing plastics and other industrially important organic compounds.

The component processes of the carbon cycle have provided living things with the necessary sources of carbon for hundreds of millions of years. If not for the recycling processes, carbon might long ago have become completely sequestered in crustal rocks and sediments, and life would no longer exist.

Human activity threatens to disrupt the natural cycle of carbon. Two important ways by which humans have affected the carbon cycle, especially in recent history, are: 1) the release of carbon dioxide into the atmosphere during the burning of fossil fuels, and 2) the clearing of trees and other plants (deforestation) that absorb carbon dioxide from the atmosphere during photosynthesis. The net effect of these actions is to increase the concentration of carbon dioxide in the atmosphere. It is estimated that global atmospheric carbon dioxide is increasing by about 0.4% annually. Carbon dioxide is a greenhouse gas (i.e., it prevents infrared radiation from the earth's surface from escaping into space).

The heat is instead absorbed by the atmosphere. Many scientists believe that the increased carbon dioxide concentration in the atmosphere is resulting in global warming.

This global warming may in turn cause significant changes in global weather, which could negatively affect all life on earth. However, increased photosynthesis (resulting from the increase in the concentration of carbon dioxide) may somewhat counteract the effects. Unfortunately, the issues of fossil fuel burning, deforestation and global warming are intertwined with economic and political considerations. Furthermore, though much studied, the processes are still not well-understood and their ramifications cannot be predicted with confidence.